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JPARC
Magnet Division Procedure

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Title: JPARC Corrector Coil Winding and Curing

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REVISION RECORD

Rev. No.	Date	Page	Subject	Approval
A	12/12/03		Initial Release	

1 Scope:

This MAP describes the procedure used for winding & curing of JPARC Corrector Coils

2 Applicable Documents:

RHIC-MAG-Q-1000	Control of Measurement Test Equipment
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-MAG-R-7242	RHIC Hypot Testing
RHIC-MAG-R-7227	Electrical Resistance Measurement for Individual Coils
RHIC-MAG-R-7228	Magnet Coil Inductance and Q Measurement
RHIC-MAG-R-7318	Dipole /Quadrupole Inductance Testing
SMD-OPM-8.1.1.32	Operation of CBA Beam Tube Wrapper
SMD-OPM-8.1.1.36	DESY Wiring Machine
RD24010001	Coil Assembly

3 Requirements:

3.1 Material/Equipment

Acetone	
Insulated Gloves	BNL Stock No. K-63025
PVC Gloves	BNL Stock No. K-62649
Latex Gloves	BNL Stock No. K-62854
Test Cart	ETS-001
Micrometer	

3.2 Safety Precautions

3.2.1 The operator shall be instructed by the Cognizant Technical Supervisor in the safe operation of the DESY Wiring Machine.

3.2.2 The operator shall be instructed by the Cognizant Technical Supervisor in the safe operation of the Beam Tube Wrapper.

3.2.3 Operators shall wear safety glasses with side shields, or goggles.

3.2.4 Operators shall wear insulated gloves when handling heated coil assembly.

3.2.5 Personnel shall wear PVC gloves while handling epoxies, Latex gloves while handling acetone, ethanol, or methanol cleaning agents.

3.2.6 The technicians shall be instructed by their cognizant technical supervisor in the operation of the required test equipment and these electrical testing procedures. They shall be familiar with the latest revision of the applicable documents referenced in section 2. In addition, some of these tests require the technician to have special training.

3.2.7 Some of these electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES&H standard. Operators shall wear safety glasses with side shields or goggles.

3.2.8 Caution: to avoid the possibility of static build-up during and discharge during coil winding operation, the following grounding must be installed. Attach a ground wire to the coil support tube. Attach incoming lead for coil block being wound to ground. After all the coil blocks are wound remove the ground wires.

3.3 Procedure

3.3.1 Wind Skew Dipole

3.3.1.1 Insulate tube with two layers of 12010181-13 kapton, 50% overlap, and mount support tube into winding machine using 4 jaw chucks and minimizing runout.

3.3.1.2 Apply substrate to insulated tube in area of both skew dipole and combined function coils, per the assembly drawing.

3.3.1.3 Measure and record diameter and runout measurements every 15^0 around circumference at 5 evenly spaced axial positions. Record data in computer.

3.3.1.4 Allowing a minimum of 6’ coil pole leads, wind the skew dipole coil layer #1using the appropriate wiring file.

3.3.1.5 Install G-10 spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.

3.3.1.6 Apply blue epoxy (2850FT[12011227] + 24LV Catalyst [12011228]) to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to eliminate any high spots. Wrap with 2 mil Teflon until cured.

3.3.1.7 Remove Teflon and apply substrate to coil assembly.

3.3.1.8 Measure and record diameter and runout measurements every 15^0 around circumference at 5 evenly spaced axial positions. Record data in computer.

3.3.1.9 Wind the skew dipole coil layer #2 using the appropriate wiring file.

3.3.1.10 Install G-10 spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate. Protect exiting leads against damage.

3.3.2 Wind Combined Function Coil

3.3.2.1 Measure and record diameter and runout measurements every 15^0 around circumference at 5 evenly spaced axial positions. Record data in computer.

3.3.2.2 Allowing a minimum of 4' coil pole leads, wind the combined function coil layer #1using the appropriate wiring file.

3.3.2.3 Install G-10 spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.

3.3.2.4 Route the skew dipole coil leads through the G-10 spacers in the combined function pattern. Protect leads from winding operation of the second layer.

3.3.2.5 Apply blue epoxy (2850FT[12011227] + 24LV Catalyst [12011228]) to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to eliminate any high spots. Wrap with 2 mil Teflon and heat shrink; leave on until cured. NOTE: Be sure not to permanently epoxy excess lead length of skew dipole coil.

3.3.2.6 Apply substrate to coil assembly.

3.3.2.7 Route the excess lead of the skew dipole coil to the top surface and then beyond the end of the combined function coil pattern, in the area where final routing will be done (G-10 pole/end section of serpentine pattern). Secure leads beyond coil pattern.

3.3.2.8 Measure and record diameter and runout measurements every 15^0 around circumference at 5 evenly spaced axial positions. Record data in computer.

3.3.2.9 Wind the combined function coil layer #2 using the appropriate wiring file.

3.3.2.10 Install G-10 spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate. Protect exiting leads against damage.

3.3.2.11 Route the skew dipole coil leads through the G-10 spacers in the combined function pattern.

3.3.2.12 Route all four exiting leads through the G-10 spacers at the coil lead end.

3.3.2.13 Perform Warm Measurements, RLQ, Hypot, and Impulse Test. Perform Hypot, Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318./7742
Warning: The safety requirements included in the individual electrical test procedures shall be followed

3.3.3 Cure Coils

3.3.3.1 Using 48" lengths of cable, stabilize the exiting leads of both coils by soldering a second piece of conductor to the main conductor. The two must be soldered in the proper configuration to exit in the slots of the G-10 spacers. Only solder up to the end of the G-10 at this time.

3.3.3.2 Overwrap stabilized leads with 67% overlap of .001" Kapton insulation.

3.3.3.3 Apply blue epoxy to coil filling in all voids between G-10 and conductor, and between conductors of the second layers of both the combined function and skew dipole coils. Squeegee away any excess to eliminate high spots.

3.3.3.4 Double overlap wrap coil with .002" Teflon.

3.3.3.5 Install coil into curing fixture. Cure @ 175^0C for 90 min

Remove coil from fixture and remove Teflon overwrap.

3.3.3.6 **Warning: Operators shall wear insulated gloves when handling heated coil**

3.3.3.7 Perform Warm Measurements, RLQ, Hypot, and Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318/7742.
Warning: The safety requirements included in the individual electrical test procedures shall be followed

3.3.3.8 Install coil assembly into fiberglass wrapping machine.

3.3.3.9 Wrap coil with .003" B-stage epoxy impregnated fiberglass tape. Use two layers of 50% overlap wrap or four layers of butt wrap, overlapping seams of successive wraps by 50%.

3.3.3.10 Wrap coil with two layers of 12010181-13 kapton tape, 50% overlap.

3.3.3.11 In same machine wrap coil with epoxy impregnated S-glass fibre @ 27 lbs. tension, 18 turns per inch.

3.3.3.12 Double overlap wrap coil with .002" Teflon.

3.3.3.13 Install coil assembly in curing fixture. Cure@122^{0}C for 90 min.

3.3.3.14 Remove coil from curing fixture and remove Teflon overwrap
Warning: Operators shall wear insulated gloves when handling heated coil.

3.3.3.15 Measure and record final diameter measurements every 15^0 around circumference at 5 axial positions for each coil.

3.3.3.16 Perform Warm Measurements, RLQ, Hypot, and Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318/7742.
Warning: The safety requirements included in the individual electrical test procedures shall be followed

4 Quality Assurance Provisions:

4.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.

4.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC- MAG-Q-1004.

4.3 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

5 Preparation for Delivery:

5.1 N/A

SAMPLE DATA SHEET

DIAMETER MEASUREMENTS – INSULATED TUBE, SD					
	POSITION				
	#1	#2	#3	#4	#5
0°					
15°					
30°					
45°					
60°					
75°					
90°					
105°					
120°					
135°					
150°					
165°					
AVG					

DIAMETER MEASUREMENTS – SD, Layer 1 Wound					
	POSITION				
	#1	#2	#3	#4	#5
0°					
15°					
30°					
45°					
60°					
75°					
90°					
105°					
120°					
135°					
150°					
165°					
AVG					

DIAMETER MEASUREMENTS – INSULATED TUBE, CF					
	POSITION				
	#1	#2	#3	#4	#5
0°					
15°					
30°					
45°					
60°					
75°					
90°					
105°					
120°					
135°					
150°					
165°					
AVG					

DIAMETER MEASUREMENTS – CF, Layer 1 Wound					
	POSITION				
	#1	#2	#3	#4	#5
0°					
15°					
30°					
45°					
60°					
75°					
90°					
105°					
120°					
135°					
150°					
165°					
AVG					

DIAMETER MEASUREMENTS – Final, SD					
	POSITION				
	#1	#2	#3	#4	#5
0°					
15°					
30°					
45°					
60°					
75°					
90°					
105°					
120°					
135°					
150°					
165°					
AVG					

DIAMETER MEASUREMENTS – Final, CF					
	POSITION				
	#1	#2	#3	#4	#5
0°					
15°					
30°					
45°					
60°					
75°					
90°					
105°					
120°					
135°					
150°					
165°					
AVG					